ELECTRICAL CONNECTOR FOR INTERCONNECTING FLAT CIRCUITS

Field of the Invention:

This invention generally relates to the art of electrical connectors and, particularly, to an electrical connector for interconnecting a pair of flat circuits.

Background of the Invention:

A wide variety of electrical connectors have been designed for terminating flat cables or circuits, such as flat flexible cables, flexible printed circuits or the like. A typical connector for a flat circuit includes a dielectric housing molded of plastic material, for instance. The housing has an elongated opening or slot for receiving an end of the flat circuit which has generally parallel, laterally spaced conductors exposed across the end. A plurality of terminals are mounted in the housing and are spaced laterally along the slot, with contact portions of the terminals engageable with the laterally spaced conductors of the flat circuit. Some flat circuit connectors of the character described above also are designed for mounting on a second flat circuit such as a printed circuit board, with the terminals interconnecting the conductors of the inserted flat circuit with conductors of the second flat circuit on which the connector is mounted. Problems continue to be encountered in securing the connectors to the second flat circuit, keeping in mind that most such connectors have very low or flat profiles.

For instance, FIGS. 10-12 show an example of an electrical connector, generally designated 12, according to the prior art for interconnecting a pair of flat circuits. The connector includes a dielectric or plastic housing, generally designated 14, having an interior cavity, generally designated 16. The cavity has an opening 18 in a front face 20 of the housing for insertion therethrough of a flat circuit, such as a flat flexible circuit, into cavity 16.

A plurality of terminals 22 are inserted into openings 24 in a rear face 26 of the housing, whereby the terminals are mounted in the housing and are spaced laterally along interior cavity or slot 16. The terminals have contact portions 22a for engaging laterally spaced conductors on the flat circuit inserted through opening 18 into cavity 16.

Housing 14 has a top face 28 and a bottom face 30 for mounting on a second flat circuit, such as a flat printed circuit board. For instance, FIG. 12 shows that terminals 22 have feet portions 22a for connection to appropriate conductors on the second flat circuit which can be considered the "base" circuit. Therefore, the terminals can interconnect the conductors of the flat circuit inserted into cavity 16 and the conductors of the base circuit.

Generally, means are provided for securing electrical connector 12 to the base circuit. Specifically, a pair of metal reinforcing members, generally designated 32, are inserted from top face 28 of the housing into a pair of through passages 34 which communicate the top face with

bottom face 30. In other words, metal reinforcing members 32 are inserted into passages 34 in the direction of arrow "A" (Fig. 12).

As seen in FIG. 12, each metal reinforcing member 32 includes a plurality of claws 32a for skiving into the plastic material of housing 12 within passage 34. The reinforcing member also has a positioning notch 32b for straddling a positioning rib 36 interiorly of the housing.

Reinforcing members 32 are provided for securing connector 12 to the base circuit and prevent removal of the connector in the direction of arrow "B" (Figs. 10 and 12). This is accomplished by securing a pair of feet 32a (Fig. 12) to mounting pads on the base circuit, as by soldering.

Unfortunately, during continuous usage and repeated insertions and removals of flat circuits into and out of cavity 16, housing 14 of connector 12 tends to loosen from metal reinforcing members 32. Claws 32a simply are insufficient to establish a secure locking engagement between the metal reinforcing members and the housing. Many of the extraneous forces on the connector operate around an imaginary axis "C" shown in FIG. 11. The housing tends to turn around this imaginary axis as a center of pivotal movement back and forth during usage of the connector. The reinforcing members may even tend to rock around positioning rib 36 of the housing. The present invention is directed to solving these problems by providing an improved locking engagement between the reinforcing members and the connector housing of a flat circuit connector.

Summary of the Invention:

An object, therefore, of the invention is to provide a new and improved electrical connector for interconnecting a pair of flat circuits.

In the exemplary embodiment of the invention, the connector includes a housing having a front mating face, a rear terminating face, a top face and a bottom face for mounting on a first flat circuit. The housing includes a cavity for receiving a second flat circuit, with the cavity having an insertion opening in the front mating face of the housing. At least one through passage extends through the housing from the top face to the bottom face thereof. A plurality of terminals are mounted in the housing along the cavity. The terminals have contact portions for engaging appropriate circuit contacts on the second flat circuit when the second flat circuit is inserted through the opening into the cavity. A reinforcing member has a body portion inserted into the through passage in the housing from the top face thereof and includes a foot portion exposed at the bottom face of the housing for securing to the first flat circuit. The reinforcing member has a locking portion extending oblique to the body portion and engageable with a locking surface on the housing.

As disclosed herein, the housing is fabricated of dielectric plastic material and the reinforcing member is fabricated of metal material. Preferably, a pair of the through passages and a corresponding pair of the reinforcing members are disposed at opposite sides of the housing. The pair of passages are located in the housing outside opposite ends of the cavity. The reinforcing members may include a plurality of claws for skiving into the plastic material of the housing within the through passages.

According to one aspect of the invention, the through passage is generally L-shaped to define a first leg extending from the top face of the housing to the bottom face thereof. A second, oblique leg of the L-shaped passage defines a recess in the top face of the housing for receiving the locking portion of the reinforcing member generally flush with the top face. Correspondingly, the reinforcing member is generally L-shaped, with the body portion and the locking portion of the reinforcing member forming the respective oblique legs of the L-shape. The body portion and the locking portion of the reinforcing member are generally planar. The planar locking portion is positioned in the recess of the through passage in the top face of the housing generally flush with the top face.

According to another aspect of the invention, the reinforcing member is stamped and formed of sheet metal material and, again, the body portion of the reinforcing member is generally planar. The foot portion of the reinforcing member is bent into a U-shaped configuration to define a tangent line of securement with the first flat circuit. The U-shaped foot portion is soldered to an appropriate circuit trace on the first flat circuit along the tangent line of securement.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

Brief Description of the Drawings:

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIG. 1 is a perspective view of an electrical connector according to the invention for interconnecting a pair of flat circuits;

FIG. 2 is a top plan view of the connector;

FIG. 3 is a vertical section taken generally along line 3-3 of FIG. 2;

FIG. 4 is a front elevational view of the connector;

FIG. 5 is a vertical section taken generally along line 5-5 of FIG. 2;

FIG. 6 is a vertical section taken generally along line 6-6 of FIG. 2;

FIG. 7 is a view similar to that of FIG. 6, but of a first alternative embodiment of the invention;

FIG. 8 is a perspective view of the metal reinforcing member of the alternative embodiment of FIG. 7;

FIG. 9 is a front elevational view similar to that of FIG. 4, partially cut-away, of a second alternative embodiment of the invention;

FIG. 10 is a perspective view of a prior art connector as described in the "Background", above;

FIG. 11 is a top plan view of the prior art connector of FIG. 10; and

FIG. 12 is a vertical section of the prior art connector, taken generally along line 12-12 in FIG. 11.

Detailed Description of the Preferred Embodiments:

Referring to the drawings in greater detail, and first to FIGS. 1 and 2, the invention is embodied in an electrical connector, generally designated 40, which includes a dielectric housing, generally designated 42, that may be molded of dielectric material such as plastic or the like. The housing has a front mating face 42a, a rear terminating face 42b, a top face 42c and a bottom face 42d for mounting the housing and the connector on a first flat circuit 43 which will be called the "base" circuit hereinafter.

Housing 42 of connector 40 mounts a plurality of terminals 44 which are inserted into the housing through a plurality of openings 46 in rear terminating face 42b of the housing. The housing includes an interior cavity or slot 46 having an insertion opening 48 in front mating face 42a of the housing for insertion thereinto of a second flat circuit 50 (Fig. 3).

Referring to FIGS. 3 and 4 in conjunction with FIGS. 1 and 2, each terminal 44 is inserted into housing 42 in the direction of arrow "D" through one of the openings 46 in rear terminating face 42b of the housing. Each terminal includes a foot portion 44a for connection, by solder fillets 45, to a circuit trace on the base flat circuit. Each terminal is bifurcated and projects forwardly into interior cavity 46, with the terminal having a pair of contact arms 44b terminating in contact portions 44c which engage appropriate circuit traces on opposite sides of the second flat circuit 50 inserted through opening 48 into interior cavity 46. Referring to FIG. 5 in conjunction with FIGS. 3 and 4, the housing defines a comb-like structure which includes ribs 52a and channels 52b as best seen in FIG. 5. Channels 52b receive contact arms 44b of the terminals, while ribs 52a separate the respective terminals.

The invention contemplates an improved system for securing connector 40 to the base flat circuit. Specifically, as seen in FIGS. 1 and 2, a pair of metal reinforcing members, generally designated 60, are inserted through top face 42c of the housing into a pair of through passages, generally designated 62, from top face 42c to and through bottom face 42d of the housing. The passages are located inside a pair of opposite side walls 64 of the housing.

Details of metal reinforcing members 60 and through passages 62 are shown in FIGS. 5 and 6. Specifically, each passage 62 is generally L-shaped to define a first leg 62a which extends from top face 42c of the housing and extends through bottom face 42d of the housing, as at 66 (Fig. 5). A second, oblique leg 62b of the L-shaped passage forms a recess in top face 42c of the connector housing.

Still referring to FIGS. 5 and 6, the metal reinforcing members are stamped and formed of sheet metal material. Each metal reinforcing member 60 also is generally L-shaped and includes a planar body portion 60a and a planar locking portion or flange 60b which are at generally right-angles to each other to define the L-shaped reinforcing member. As seen in FIG. 5, when metal reinforcing members 60 are inserted into passages 62, body portions 60a of the reinforcing members extend through first legs 62a of the passages and locking portions or flanges 60b of the reinforcing members become positioned in recesses 62b in the top face of the housing. It can be seen in FIG. 5 that locking flanges 60b of the metal reinforcing members are generally flush with top face 42c of the housing. Feet portions 60c at the distal ends of legs 60a of the reinforcing members are exposed at bottom face 42b of the housing for securement, by solder fillets 68, to appropriate mounting pads on the base flat circuit. A bottom surface 70 of each recess 62b defines a locking surface against which locking portions 60b abut. Therefore, if forces are applied to connector 40 in the direction of arrow "E" (Figs. 5 and 6), these forces are opposed by the engagement of the rather large planar locking flanges 60b of metal reinforcing members 60 and locking surfaces 70 of the connector housing.

FIG. 6 shows that each metal reinforcing member 60 has a pair of claws 72 at opposite edges of planar body portion 60a for skiving into the plastic material of housing 42 within passage 62 to provide a retention means to retain the reinforcing members within their respective passages of the housing.

FIGS. 7 and 8 show a first modified version of a metal reinforcing member, generally designated 60A, which serves the same purpose as reinforcing member 60 described above. Modified reinforcing member 60A is similar to reinforcing member 60 in that it is generally L-shaped with a planar body portion 60a and a planar locking portion or flange 60b. In addition, claws 72 are provided at opposite edges of the body portion for skiving into the plastic material of the housing.

The difference between modified reinforcing member 60A and reinforcing member 60, above, is that the modified reinforcing member in FIGS. 7 and 8 include additional locking portions 80 in the form of arms which are coplanar with body portion 60a. As can be seen in FIG. 7, these locking arms 80 project outwardly from body portion 60a and are engageable with a pair of locking surfaces 82 on housing 42 of connector 40.

FIG. 9 shows a second modified version of a metal reinforcing member, generally designated 60B, which serves the same purpose as reinforcing members 60 and 60A described above. Modified reinforcing member 60B is similar to reinforcing members 60 and 60A in that it is stamped and formed of sheet metal material in a generally L-shaped configuration, with a planar body portion 60a and a planar locking portion or flange 60b.

The difference in modified reinforcing member 60B is that foot portion 60c at the distal end of body portion 60a is bent into a U-shaped configuration to define a tangent line of securement 60d with base flat circuit 43. The tangent line of securement 60d extends the entire length of distal end 60c of planar body portion 60a as can be understood from FIGS. 6 and 7 of the previous versions. The U-shaped foot portion is secured to the base flat circuit by solder fillets 84 which run along opposite sides of the tangent line of securement 60d. The advantages of providing U-shaped feet portions is that very uniform curved surfaces are provided at the solder fillets for easy deposit of the solder material and considerably improved mounting strength.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.